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Can Topography Explain The Variability Of Regional Seismic Signals? Finite-Difference Calculation.

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Key to the monitoring of a Comprehensive Test Ban Treaty (CTBT) is the ability to identify seismic events in various regions of the world down to low magnitudes. At these lower magnitudes, events are typically recorded only at regional distances. Distances at which many identification techniques are currently inadequate because their performance becomes a strong function of the crustal and mantle structure local to the region of application. Numerical modeling can help. By decoupling different structural effects, modeling can be used to isolate their independent responses and develop a physical basis for the behaviour of the conventional seismic identification techniques. In this regard, recent empirical studies have shown a strong correlation of crustal guided seismic phases with free-surface topography. In this study, we utilize finite-difference modeling to determine to what order free-surface topography, by itself, affects the propagation of seismic phases.

The seismic response of regional phases to free-surface topography is modeled using the density-extinguishing approximation with a fourth-order, velocity-stress finite-difference technique. Given that the extinguishing of density using a taper is a rather course approximation that has not been rigorously benchmarked in the literature, we first present a number of tests that carefully map the techniques accuracy. In addition, artifacts inherent in the approximation are identified and reduced by modifying the algorithm with the application of spatial filters. Utilizing this modified density extinguishing technique, we investigate the effect that topography alone has on the propagation of high frequency guided crustal phases. Modeling topography as a fractal process and running numerous models of the regional response to such structure, we correlate regional phase variations with free-surface topography.

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